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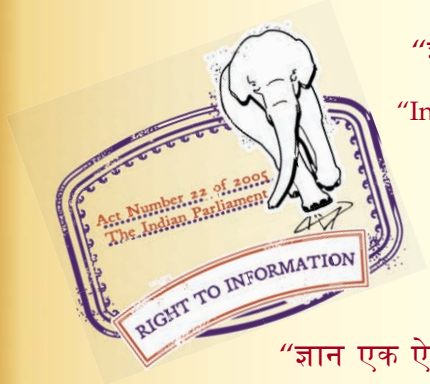
IS 10609 (1983): Refrigerants - Number designation [MED 3: Refrigeration and Air Conditioning]



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"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS : 10609 - 1983

(Reaffirmed 1999)

Indian Standard

REFRIGERANTS — NUMBER DESIGNATION

1. Scope

1.1 Establishes a simple numbering system of referring to common refrigerants instead of using the chemical name, formula or trade name. Although the use of a number for each refrigerant covered is a concise and accurate way of designating the refrigerant, there is no intention of precluding the use of a chemical name or formula.

2. Terminology

2.1 *Refrigerant* — The medium for conveying heat in a refrigerating system, being evaporated by absorbing heat at a lower temperature, and liquefied by surrendering heat at a higher temperature.

2.2 *Compound* — A substance formed by the union of two or more elements in definite proportions by mass.

2.3 *Hydrocarbon* — A compound containing only the elements hydrogen and carbon.

2.4 *Halocarbon* — A halogenated hydrocarbon containing one or more of the following halogens — fluorine, chlorine, bromine, and iodine.

2.5 *Isomer* — One of a group of compounds having the same combination of elements, but arranged spatially in different ways.

2.6 *Mixture* — A complex of two or more compounds which do not bear a fixed proportion to one another, and which, however thoroughly mixed together retain a separate existence.

2.7 *Azeotrope* — A mixture of refrigerants in certain proportions which behaves as a pure substance.

3. Classification

3.1 Refrigerants are classified as indicated in the nomenclature given in Table 1.

4. Numbering System

4.1 *Carbon Compounds* — The identifying numbers assigned to the hydrocarbons and halocarbons of the methane, ethane, propane, and cyclobutane series are such that the structure of the compounds may be deduced from the refrigerant numbers, and *vice versa*, without ambiguity. The rules of the fixed number systems are as follows.

4.1.1 The first digit on the right is the number of fluorine (F) atoms in the compound.

4.1.2 The second digit from the right is the one more than the number of hydrogen (H) atoms in the compound.

4.1.3 The third digit from the right is one less than the number of carbon (C) atoms in the compound. When this digit is zero, it is omitted from the number.

4.1.4 The number of chlorine (Cl) atoms in the compound is found by subtracting the sum of the fluorine (F) and hydrogen (H) atoms from the total number of atoms which can be connected to the carbon (C) atoms.

When only 1 carbon atom is present, the total number of attached atoms is 4. When 2 carbon atoms are present the total number of attached atoms is 6, unless the compound is mono-unsaturated, in this case, the total number of attached atoms is 4.

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For saturated hydrocarbons, the total number of attached atoms is the following:

For 1 C, the total number of atoms is 4
For 2 C, the total number of atoms is 6
For 3 C, the total number of atoms is 8
For 4 C, the total number of atoms is 10, etc
For n C, the total number of atoms is $2n+2$

For mono-unsaturated and cyclic saturated hydrocarbons, the total number of attached atoms is the following:

For 2 C, the total number of atoms is 4
For 3 C, the total number of atoms is 6
For 4 C, the total number of atoms is 8
For 5 C, the total number of atoms is 10, etc
For n C, the total number of atoms is $2n$

4.1.5 For cyclic Perivatives the letter C is used before the identifying refrigerant number.

4.1.6 In those instances where bromine is present in place of part or all of the chlorine, the same rules apply except that the letter B after the designation for the parent chloro-fluoro compound shows the presence of bromine (Br). The number following the letter B shows the number of bromine atoms present.

4.1.7 In the case of isomers of the ethane series, each has the same number and the most symmetrical one is indicated by the number without any letter following it. As the isomers become more and more unsymmetrical, the letters a, b, c, etc, are appended. Symmetry is determined by adding the atomic masses of the groups of elements attached to each carbon atom and subtracting one sum from the other. The smaller the difference, the more symmetrical the product.

4.1.8 In the case of the ethylene series, the above rules apply, except that the number 1 is used as the fourth digit from the right.

4.2 *Azeotropes and Mixtures* — Azeotropes and mixtures are designated by their respective refrigerant numbers and mass proportions. Refrigerants are named in order of increasing boiling points. For example, a 90% and 10% mixture of refrigerants 22 and 12 will be indicated as R 22/12 (90/10), or R 22/R 12 (90/10) or Refrigerant 22/Refrigerant 12 (90/10).

4.2.1 Arbitrary identifying numbers of the 400 series are assigned to mixtures.

4.2.2 Arbitrary identifying numbers of the 500 series are assigned to azeotropes.

4.3 *Miscellaneous Organic Compounds and Inorganic Compounds* — The 600 series is assigned to miscellaneous organic compounds and the 700 series to inorganic compounds.

4.3.1 Within the organic 600 series, the assignments are arbitrary.

4.3.2 Within the inorganic 700 series, the molecular mass of the componds are added to 700 to arrive at the identifying refrigerant numbers.

4.3.3 When two or more inorganic refrigerants have the same molecular mass, the first assignment will be by number only, the second by number plus the letter A, the third by number plus the letter B, etc.

5. Designation

5.1 *Form*

5.1.1 The identifying number is preceded by the letter symbol "R" or used in combination with the word "Refrigerant" (or its equivalent translation) and shall be equally comprehensible in all cases.

The identifying number may also be preceded by the manufacturer's trade-mark or trade name :

Example :

R 12 or Refrigerant 12
(Trade name) R12
(Trade name) Refrigerant 12
(Trade name) 12 Refrigerant, or
(Trade name) 12

5.2 *Use on Nameplates and in Textual Matter*

5.2.1 Designation of a refrigerant on a nameplate or in specifications shall be transcribed as R 12 or Refrigerant 12, R 22 or Refrigerant 22.

5.2.2 In text or manual writing, the following manner of expression is acceptable.

The compressor can be used with R 12 or R 22,
The compressor can be used with Refrigerants 12 or 22,
The comrpessor can be used with Refrigerant 12 or Refrigerant 22.

TABLE 1 ORGANIC REFRIGERANT NOMENCLATURE
(*Clause* 3.1)

Refrigerant Number Designation	Chemical Name	Chemical Formula	Molecular Mass	Boiling Point at Pressure of 101·3 kPa
(1)	(2)	(3)	(4)	(5) °C
Miscellaneous Organic Compounds				
Hydrocarbons				
50	Methane	CH_4	16·0	—161
170	Ethane	CH_3CH_3	30·1	—89
290	Propane	$CH_3CH_2CH_3$	44·1	—42
600	Butane	$CH_3CH_2CH_2CH_3$	58·1	0
600a	2-Methylpropane (Isobutane)	$CH(CH_3)_3$	58·1	—12
*				
Oxygen Compounds				
610	1, 1'-Oxybis [ethane] (Ethyl ether)	$C_2H_5OC_2H_5$	74·1	35
611	Methyl formate	$HCOOCH_3$	60·0	32
Sulfur Compounds				
620				
Nitrogen Compounds				
630	Methanamine (Methyl amine)	CH_3NH_2	31·1	—6
631	Ethanamine (Ethyl amine)	$C_2H_5NH_2$	45·1	17
Inorganic Compounds†				
702	Hydrogen	H_2	2·0	—253
704	Helium	He	4·0	—269
717	Ammonia	NH_3	17·0	—33
718	Water	H_2O	18·0	100
720	Neon	Ne	20·2	—246
728	Nitrogen	N_2	28·1	—196
729	Air	—	29·0	—194
732	Oxygen	O_2	32·0	—183
740	Argon	A	39·9	—186
744	Carbon dioxide	CO_2	44·0	—78 (sublimes)
744A	Nitrogen oxide (Nitrous oxide)	N_2O	44·0	—91
764	Sulfur dioxide	SO_2	64·1	—10
Unsaturated Organic Compounds				
1112a	1, 1-Dichloro-2, 2-difluoroethane	$CCl_2=CF_2$	132·9	19
1113	Chlorotrifluoroethane	$CClF=CF_2$	116·5	—28
1114	Tetrafluoroethane	$CF_2=CF_2$	100·0	—76
1120	Trichloroethane	$CHCl=CCl_2$	131·4	88
1130	(E)-1, 2-Dichloroethane	$CHCl=CHCl$	96·9	48
1132a	1, 1-Difluoroethane (Vinyldene fluoride)	$CH_2=CF_2$	64·0	—82
1140	Chloroethane (Vinyl chloride)	$CH_2=CHCl$	62·5	—14
1141	Fluoroethane (Vinyl fluoride)	$CH_2=CHF$	46·0	—72
1150	Ethene (Ethylene)	$CH_2=CH_2$	28·1	—104
1270	1-Propene (Propylene)	$CH_3CH=CH_2$	42·1	—48

*The compounds ethene and 1-propene might appear in the hydrocarbon section in order to indicate that these compounds are hydrocarbons. Ethene and 1-propene are properly identified under unsaturated organic compounds.

†The assignment of 700 series numbers to compounds does not preclude the use of a chemical name or formula, if desired.

(*Continued*)

TABLE 1 ORGANIC REFRIGERANT NOMENCLTURE — *Contd*

Refrigerant Number Designation	Chemical Name	Chemical Formula	Molecular Mass	Boiling Point at Pressure of 101·3 kPa
(1)	(2)	(3)	(4)	(5) °C
Halocarbon Compounds				
10	Tetrachloromethane (Carbontetrachloride)	CCl_4	153·8	77
11	Trichlorofluoromethane	CCl_3F	137·4	24
12	Dichlorodifluoromethane	CCl_2F_2	120·9	—30
12B1	Bromochlorodifluoromethane	$CBrClF_2$	165·4	—4
12B2	Dibromodifluoromethane	CBr_2F_2	209·8	25
13	Chlorotrifluoromethane	$CClF_3$	104·5	—81
13B1	Bromotrifluoromethane	$CBrF_3$	148·9	—58
14	Tetrafluoromethane (Carbontetrafluoride)	CF_4	88·0	—128
20	Trichloromethane (Chloroform)	$CHCl_3$	119·4	61
21	Dichlorofluoromethane	$CHCl_2F$	102·9	9
22	Chlorodifluoromethane	$CHClF_2$	86·5	—41
23	Trifluoromethane	CHF_3	70·0	—82
30	Dichloromethane (Methylene chloride)	CH_2Cl_2	84·9	40
31	Chlorofluoromethane	CH_2ClF	68·5	—9
32	Difluoromethane (Methylene fluoride)	CH_2F_2	52·0	—52
40	Chloromethane (Methyl chloride)	CH_3Cl	50·5	—24
41	Fluoromethane (Methyl fluoride)	CH_3F	34·0	—78
50	Methane*	CH_4	16·0	—161
110	Hexachloroethane	CCl_3CCl_3	236·8	185
111	Pentachlorofluoroethane	CCl_3CCl_2F	220·3	135
112	1,1,2,2-Tetrachloro-1,2-difluoroethane	CCl_2FCCl_2F	203·8	93
112a	1,1,1,2-Tetrachloro-2,2-difluoroethane	CCl_3CClF_2	203·8	91
113	1,1,2-Trichloro-1,2,2-trifluoroethane	CCl_2FCClF_2	187·4	48
113a	1,1,1-Trichloro-2,2,2-trifluoroethane	CCl_3CF_3	187·4	46
114	1,2-Dichloro-1,1,2,2-tetrafluoroethane	$CClF_2CClF_2$	170·9	4
114a	1,1-Dichloro-1,2,2,2-tetrafluoroethane	CCl_2FCF_3	170·9	4
114B2	1,2-Dibromo-1,1,2,2-tetrafluoroethane	$CBrF_2CBrF_2$	259·9	47
115	Chloropentafluoroethane	$CClF_2CF_3$	154·6	—39
116	Hexafluoroethane	CF_3CF_3	138·0	—79
120	Pentachloroethane	$CHCl_2CCl_3$	202·3	162
123	2,2-Dichloro-1,1,1-trifluoroethane	$CHCl_2CF_3$	152·9	27
124	2-Chloro-1,1,1,2-tetrafluoreothane	$CHClFCF_3$	136·5	—12
124a	1-Chloro-1,1,2,2-tetrafluoroethane	CHF_2CClF_2	136·5	—10
125	Pentafluoroethane	CHF_2CF_3	120·0	—49
133a	2-Chloro-1,1,1-trifluoroethane	CH_2ClCF_3	118·5	6
140a	1,1,1-Trichloroethane	CH_3CCl_3	133·4	74
142b	1-Chloro-1,1-difluoroethane	CH_3CClF_2	100·5	—10
143a	1,1,1-Trifluoroethane	CH_3CF_3	84·0	—47
150a	1,1-Dichloroethane	CH_3CHCl_2	98·9	60
152a	1,1-Difluoroethane	CH_3CHF_2	66·1	—25
160	Chloroethane (Ethylchloride)	CH_3CH_2Cl	64·5	13
170	Ethane*	CH_3CH_3	30·1	—89
218	Octafluoropropane	$CF_3CF_2CF_3$	188·0	—37
290	Propane*	$CH_3CH_2CH_3$	44·1	—42
Cyclic Organic Compounds				
C316	1,2-Dichloro-1,2,3,3,4,4-hexafluorocyclobutane	$C_4Cl_2F_6$	232·9	60
C317	Chloroheptafluorocyclobutane	C_4ClF_7	216·5	26
C318	Octafluorocyclobutane	C_4F_8	900·0	—6
	Composition	**Azeotropic Temp°C**		
Azeotropes†				
500	R 12/152a (73·8/26·2 wt%)	0	99·3	—33
501‡	R 22/12 (75/25 wt%)	—41	93·1	—41
502	R 22/115 (48·8/51·92 wt%)	19	111·6	—45
503	R 23/13 (40·1/59 wt%)	—88	87·5	—88
504	R 32/115 (48·2/51·8 wt%)	17	79·2	—57
505‡	R 12/31 (78·0/22·0 wt%)	115	103·5	—30
506	R 31/114 (55·1/44·9 wt%)	18	93·7	—12

*The compounds methane, ethane, and propane appear in the halocarbon section in their proper numerical positions, although these products are not halocarbons.

†All azeotropic refrigerants, by their nature, exhibit some segregation of components at conditions of temperature and pressure other than those at which they were formulated. The exact extent of this segregation depends on the particular azeotrope and hardware system of configuration.

‡The exact composition of this azeotrope is in question and additional experimental studies are needed.

EXPLANATORY NOTE

This standard is based on ISO/R 817 Organic Refrigerants—Number designation, published by the International Organization for Standardization. The standard also takes into account Doc : ISO/TC 86/SC 8 N26 Second Working Draft Revision of ISO/R 817.

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